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ULTRAVIOLET RADIATION OF THE SUN AND THE TRANSITION LAYER BETWEEN CHROMOSPHERE AND CORONA

by G.S.Ivanov-Kholodny and G.M.Nikolsky

Abstract

I. Most of the solar ultraviolet lines are emitted by the transition region and the corona. In the spectral ranges of 1000-2000 A° /I-6/ and 84-I200 A° are recorded $\sim$200 lines by means of the rocket spectrographs /7/.

2. The calibration was carried out in absolute units and as a result of this there were abtained $J(L_{\alpha}) = 3$, $J(He\,II\,\lambda 304) = 1,2$ and $J(He\,II\,\lambda 584) = 0.1$ erg $cm^{-2} sek^{-1}$. These values are consistent with the recent ionospheric data according which the intensity of the ultraviolet radiation for $\lambda < 900$ A° is $\sim$ 30 erg $cm^{-2} sec^{-1}$ /8/.

3. From the theoretical consideration of atomic ionization and excitation in the transition region there follows an expression for the "luminosity function" of $\Delta\varphi_i$ for a given ion:

$$\Delta\varphi_i = \left\{ n_e^2 T_i^{-3/2} (h_2 - h_1) \right\} = \frac{2,3 \cdot 10^{12} \cdot J \cdot \lambda}{\varkappa \cdot W' \cdot f_{12}}, \qquad (I)$$

where h_2 and h_1 are the upper and the lower heights of emitted layer accordingly, f_{12} - the oscillator strengths of the corresponding atomic transition, λ - wave length of an ultraviolet line and $\varkappa$ - the abundance of the element relative to the hydrogen. The probability of excitation of a given a atomic level as an effect of electron collision is a function o of T

$$W' = 10 \cdot T^{-3/2} \left\{ \frac{e^{-x}}{x} - E_i(x) \right\}, \qquad (2)$$

where $E_i(x) = \int_x^{\infty} \frac{e^{-x}}{x} dx$, $x = \frac{h\nu}{kT}$.

4. Data regarding the 17 ultraviolet lines were used and two empirical relations were established

$$\Delta\varphi_i = f(T_i) \text{ (fig.1) and } T(h_2) - T(h_1) = 2 \cdot T_i^{0,92} \quad (3)$$

From fig.1 it is seen that the abudance of nitrogen $\alpha(N) \approx 10^{-5}$, i.e. it is about 30 times less as compared to the one usually assumed.

5. The self absorption in the ultraviolet lines was found to be negligible although the optical depth may be large.

6. From this there were calculated ultraviolet and X-ray continuums, emitted by the transition region and the corona it was concluded that according to the rocket observations the solar radiation in the spectral range of 30-1500 A° mainly consists of line emission.

7. Radioemission as calculated using (4) is in accordance with the observations if one assumes, that during the maximum solar cycle at least 90% of ultraviolet radiation are emitted by active regions in case they occupy ~0.1 of the solar surface and are ~100 times brighter than the undisturbed region.

8. Eclipse data of Athay and al. /9/, were used for estimating a function:

$$\psi(h) = \int_h^\infty n_e^2 T^{-3/2} dh \quad (5)$$

for active and undisturbed regions of the chromosphere. From (4) and (5) the distributions of T and n_e with height were found, and thus models of active and undisturbed transition regions were constructed (fig.2). Temperature in the transition region changes with height smoother than in previous models.

(Preliminary results are published in /10/).

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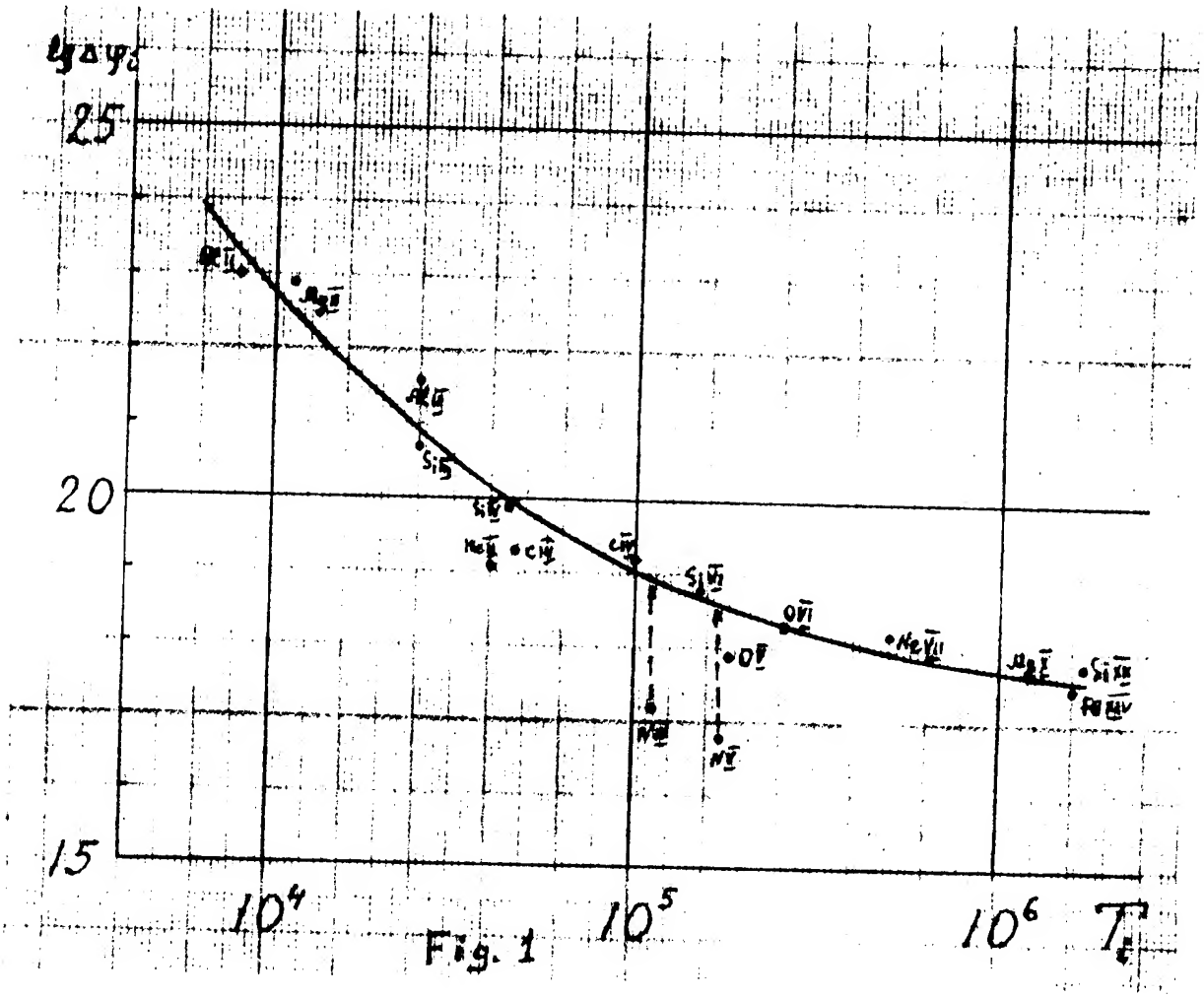

Fig. 1

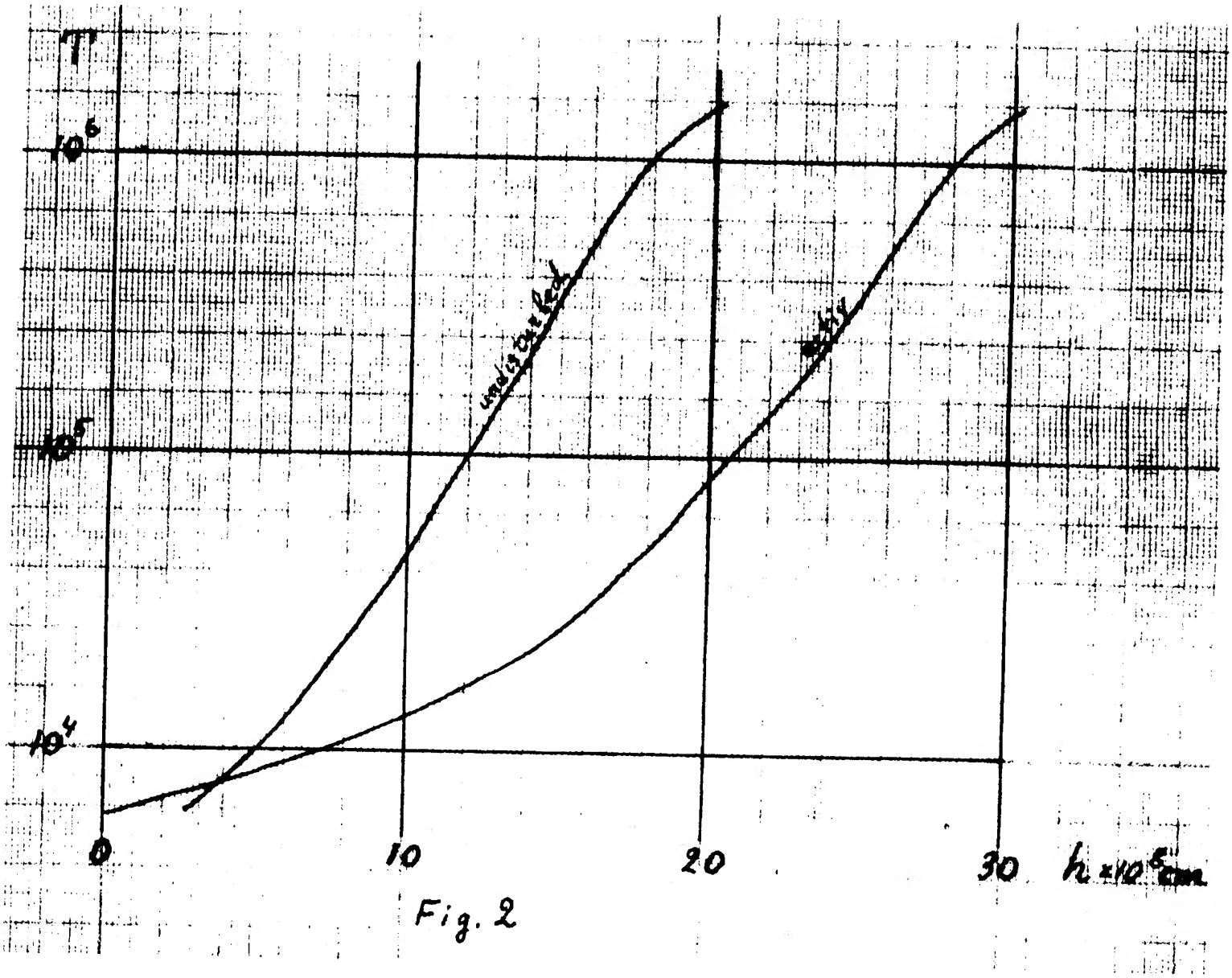

Fig. 2